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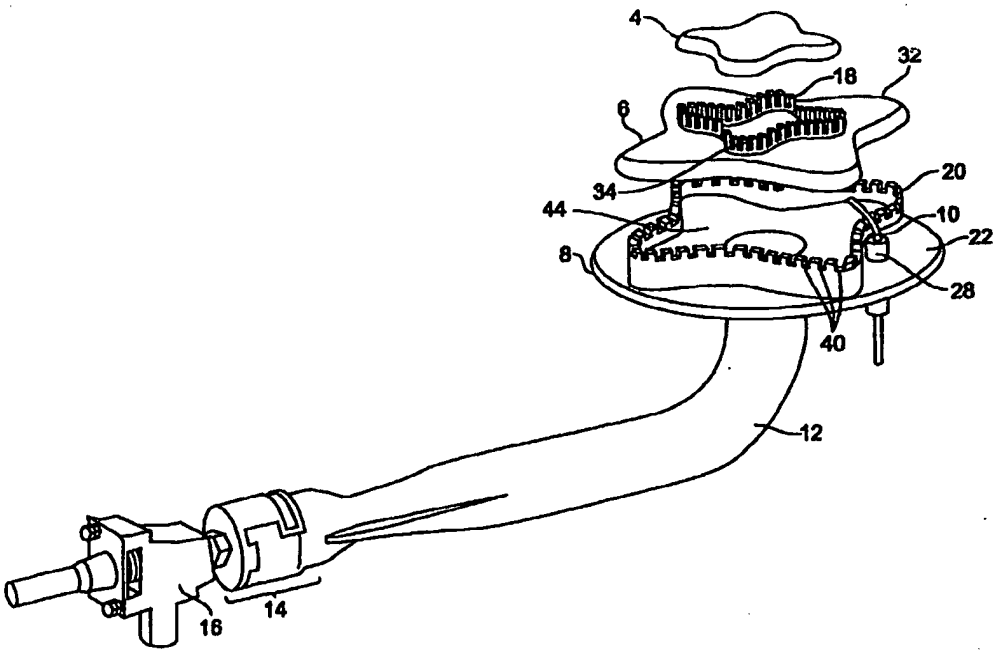

(57) Abstract

The present invention provides a novel burner design for use in natural gas burning stoves. A multi–tiered sealed burner head (2) is described that is capable of wide range of heat energy output rates. In low energy output applications, an upper port ring (18) is active. In high energy output applications, a lower burner port ring (20) becomes automatically activated. The burner (2) of the present invention includes multiple burner port rings that are arranged in a concentric stack.

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VARIABLE INPUT GAS TOP BURNER

BACKGROUND OF THE INVENTION

Technical Field

The present invention relates generally to a mechanism to control the combustion of a natural gas/air mixture. More particularly, the invention relates to a variable input gas top burner.

Background Art

Natural gas has been used for many years to provide a source of heat for consumer use. One of the principal uses of natural gas has been in the preparation of food.

When used to cook food, a combustible natural gas/air mixture is ignited and burned in a controlled fashion to produce heat energy for food preparation. Although this technology is well known, it still suffers from several limitations. A principal limitation is the limited range of fuel flow rates that can be effectively used in gas burners currently known in the art. This results in difficulty in obtaining the optimum rate of heat energy transfer for each specific application.

When preparing food, it is often desirable to vary the rate at which heat energy is transferred into the food over a wide range of rates. For example, in some applications it is desirable that the heat energy be transferred at an extremely low rate, for example, in simmering applications. On the other hand, it is frequently required that heat energy be transferred at an extremely high rate, for example, in reheating or browning or other processes that require a high heat.

Current burner technology provides only a limited range of rates of heat energy transfer. This is a result of the fact that current burner technology permits only a limited range of fuel flow rates at which the fuel/air mixture can be effectively utilized. This limited range is a result of the fact that currently available burner tops deliver the fuel/air mixture to all ports simultaneously. This results in the lowest useful fuel flow rate being

determined by the minimum pressure of fuel/air mixture that can be evenly distributed so as to exit all ports simultaneously.

There exists a need in the art for a burner head design that provides a wider range of combustion rates. Ideally, the burner head should be configured so that this wide range of operation is automatically attained by simply varying the rate at which the fuel/air mixture is delivered to the burner head.

The need for a smaller burner for simmer operations was observed on conventional style gas top burners. The concept of "stacking" a small burner head on top of a larger base was thought to accomplish two functions with one device.

SUMMARY OF THE INVENTION

The present invention is a sealed, variable input gas top burner with integral electrical spark ignition and full flame sensing capability. The structure includes multiple burner caps of varying geometry and height which act to contain and form coincident fuel/air port pathways for various input rates. The base section of the burner head incorporates a lower burner port ring, support for an ignition electrode, and a blended mounting flange which may be a separate component. A fuel/air mixture is supplied to the burner base by a conventional venturi tube whose diameter is determined by the maximum burner input rate.

A unique feature of the present invention is the sealed, multi-tiered arrangement of burner ports. The burner ports share a common fuel/air mixture conveying tube. This simplicity of design obviates the need for multiple gas lines and gas control elements, while providing a broad range of possible fuel/air mixture input rates. This results in a simple design that attains the desirable goal of high turn-down ratios.

In operation, a variable throughput gas valve with an integral limiting orifice supplies the burner. The orifice injects gas into the mixer portion of the venturi for propagation into the burner head proper, where even distribution is provided for the by burner porting. The fuel/air mixture exits

the burner head through the porting and is ignited by an electric arc from a spark electrode.

In addition to igniting the fuel/air mixture, the spark electrode provides an additional flame sensing capability. The electrode wire is located such that flame engulfs the electrode tip throughout the entire range of possible fuel/air input rates. The flame creates an electrical circuit that sends a signal to a spark module where the signal is decoded to sense the presence of a flame.

The multiple burner cap design of the present invention provides the unique operational feature that a wide range of combustion rates is attainable. The burner turn down ratio is the ratio of the highest attainable energy output rate in btu/unit time to the lowest energy output rate. Burners of the prior art obtain turn down ratios of approximately 10:1. With the novel design of the present invention, turn-down ratios of approximately 50:1 are attainable.

Without being bound by theory, the present invention is understood to work according to the following principles.

Fuel is mixed with air in a conventional venturi and delivered to the burner head. When the fuel/air mixture is delivered at low rates, it exits the burner head through the upper burner ports. As the fuel/air mixture is delivered at higher input rates, the efflux of the mixture through the upper ports is restricted by the small size of the upper ports. When the fuel/air mixture input rate exceeds the rate of efflux through the upper burner ports, the fuel/air mixture begins to exit through the lower burner ports. As the fuel/air mixture exits the lower burner ports, it is carried up into the flame in the upper port and is ignited. This ignition results in flame being transmitted down to the lower ring.

The geometry of the burner design and the igniter design and location facilitates ignition of the small burner port under low fuel/air mixture input rates. As the input rate increases to the point that the fuel/air mixture begins to exit from the larger ports, the flame from the small port will propagate to the fuel/air mixture exiting the larger port and ignite that fuel/air mixture.

The variable input gas top burner, according to the present invention, may have an upper burner port assembly and a base assembly that includes a lower burner port ring. The base assembly may be attached to a fuel/air

mixture conveying tube that is attached to a conventional venturi. A variable throughput gas valve is attached to the venturi and controls the gas input into the venturi.

The variable input gas top burner, according to the present invention, is provided with a flame sensing ignition electrode. The flame sensing ignition electrode may be attached to the base assembly and may be positioned adjacent to the upper burner port assembly in such a fashion as to be able to sense the presence of flame in both the upper burner port assembly and the lower burner port assembly simultaneously.

In one embodiment of the present invention, the upper burner port assembly is formed of one piece. In alternative embodiments, the upper burner port assembly can be formed with a discrete top plate and a discrete upper burner port ring permanently affixed to an upper burner plate. In another embodiment, the upper burner port assembly comprises a discrete top plate, discrete burner port ring that is removably affixed to a discrete upper burner plate.

In one embodiment of the present invention, the base assembly is formed of one piece and comprises a lower burner port ring. Alternatively, the base assembly can be formed from a discrete flange piece to which is removably attached a discrete lower burner port ring.

These and other features of the present invention will be more readily understood with reference to the accompanying figures and detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of the assembled burner head of the present invention.

Figure 2 is an exploded view of the burner head of the present invention.

Figure 3 is a cross-sectional view of the burner head of the present invention.

Figure 4 is a cross-sectional view of the burner head of the present invention showing ignition carry-down/up.

Figure 5 is a top view of a burner port ring of the present invention.

BEST MODE OF CARRYING OUT THE INVENTION

The following detailed description of the invention may be better understood with reference to figures 1-5. Figure 1 shows a perspective view of an embodiment of the burner head assembly **2**. In figure 2, the burner head assembly **2** is seen to comprise a top plate **4**, an upper port assembly **6**, and a base assembly **8**. The top plate **4**, upper port assembly **6**, and base assembly **8**, taken in combination form a housing **42**. The housing defines a gas distribution space **44**. The lower burner ports **40** and upper burner ports **34** are in fluid communication with the gas distribution space **44**. The base assembly **8** is connected to a fuel/air mixture conveying tube **12**. The distal end of the fuel/air mixture conveying tube **12** is equipped with a venturi **14** connected to a variable throughput gas valve **16**.

The base assembly **8** is equipped with a lower burner port ring **20** to which is attached a flange **22**. In one embodiment, the flange **22** and the lower burner port ring **20** form one piece. In an alternative embodiment, the lower burner port ring **20** is removably attached to the flange **22** by any conventional fastening device, such as screws, clips or a frictional fit. This arrangement will permit an easier cleaning of the base assembly. The lower burner port ring **20** defines the lower burner ports **40**.

The upper port assembly **6** rests on top of the base assembly **8**. The upper burner plate **32** contacts the lower burner port ring **20**. The position of the upper burner plate relative the lower burner port ring may be maintained by gravity. Optionally, the upper burner plate **32** may be reversibly attached to the lower burner port ring **20** by clips, screws or a frictional fit. In a preferred embodiment, the upper burner plate **32** frictionally engages the lower burner port ring **20**, thereby maintaining its position.

The upper port assembly **6** comprises an upper burner plate **32**, an upper burner port ring **18**, and a top plate **4**. In one embodiment, the upper port assembly **6** is formed as one piece. In an alternative embodiment, the upper burner port ring **18** and the top plate **4** are formed as one piece and are

removably attached to the upper burner plate **32** by any conventional fastening device such as screws, clips or a frictional fit. In another embodiment, the burner port ring **18** and upper burner plate **32** are formed as one piece. The top plate **4** may be attached thereto by conventional methods. In an alternative embodiment, the top plate **4**, upper burner port ring **18**, and upper burner plate **32** are all formed as separate pieces that can be attached together by conventional methods.

The burner port ring **18** defines a plurality of upper burner ports **34**. The number and size of the burner ports **34** control the rate at which the fuel/air mixture can exit the burner. One skilled in the art will readily appreciate that, by varying the number and size of the burner ports **34**, burner heads with a variety of possible combustion rates can be obtained. This permits the construction of a burner head with a wide variety of turn-down ratios.

When completely assembled, the top plate **4** rests on the upper burner port ring **18**. This closes off the top of the burner assembly **2**. When the fuel/air mixture enters the burner head, it rises until further progress is blocked by the top plate **4**. This causes the fuel/air mixture to exit the burner assembly through the upper burner ports **34**.

A unique feature of the present invention is the formation of a housing by the top plate **4**, upper port assembly **6**, and base assembly **8**. As can be readily appreciated by those skilled in the art, both the burner ports located in the lower portion of the housing **40** and the burner ports located in the upper portion of the housing **34** are in fluid communication with the same inert gas distribution space. This is in contrast to previously described burners, wherein multiple burner ports are fed from separate fuel/air distribution tubes.

The burner head of the present invention may be equipped with an ignition electrode **10** that provides a spark to ignite the fuel/air mixture. In a preferred embodiment, the ignition electrode **10** is provided with a flame sensing capability. The orientation of the ignition electrode **10** and the flame **36** may be that shown in figure 1 where the electrode **10** is proximal to the outermost projecting portion of the upper burner port ring **18** and proximal to the innermost retracted portion of the lower burner port ring **20**. Figure

4 illustrates how flame **36** contacts un-ignited fuel/air mixture **38** as the capacity of the upper port assembly **6** is exceeded by the input rate of the fuel/air mixture resulting in flame carry down.

The ignition electrode **10** is equipped with an ignition electrode housing **28**. The flange **22** is adapted to receive the ignition electrode housing **28**. In one embodiment, the ignition electrode housing **28** forms an integral part of the flange **22**. In an alternative embodiment, flange **22** defines an opening into which ignition electrode housing **28** can be inserted. In one embodiment, the hole in flange **22** may be threaded so as to receive threads present on the exterior of ignition electrode housing **28**. Alternatively, ignition electrode housing **28** may be secured to flange **22** by brackets **30** as seen in figure 3. One skilled in the art will recognize that the brackets may be an integral part of the flange or the ignition electrode housing, or may be a separate piece. The bracket may be reversibly attached to both the flange **22** and the ignition electrode housing **28** by any conventional fastener. Alternatively, the bracket may be attached to the flange **22** and frictionally engage the ignition electrode housing **28**.

Figure 5 shows a top view of a preferred embodiment of the upper burner port ring **18**. In this embodiment, the ring has a generally square shape with rounded corners. The sides of the square may be indented so as to increase the length of the periphery of the burner port ring. This increase is length results in an increased area of contact with the air exterior to the burner port ring, thereby increasing the efficiency of combustion of the fuel/air mixture as it exits the burner head proper. One skilled in the art will readily appreciate that other shapes can be substituted for the embodiment shown without affecting the function of the device. In general the burner port rings will shaped like polygons and may display indented sides. In various embodiments, the polygons may be regular, having all sides of the same length, or may not be regular and have sides of varying lengths.

The present invention has been described in terms of a particular embodiment. One skilled in the art will readily appreciate that it is possible to construct burner heads with more than two burner port assemblies, i.e., three, four, or more assemblies may be stacked. This will provide an even broader range of turn-down ratios.

Various combinations of shapes of burner port rings and number of burner port assemblies may be constructed so as to vary the performance characteristics of the burner head. These various arrangements are within the scope of the present invention. In a preferred embodiment, the upper burner port ring will be similar in shape to the lower burner port ring. In other embodiments, the upper burner port ring may not have a shape similar to that of the lower burner port ring. All that is required is that the lower burner port ring be constructed so as to permit flame carry-down from the upper burner port ring to the lower burner port ring.

Although the invention has been described in terms of a preferred embodiment, it is understood that the invention is not limited to this embodiment, but is intended to include all other forms and versions that fall within the spirit and scope of the claims.

WE CLAIM:

1. A variable input gas top burner for producing a flame with a widely variable heat transfer rate, comprising:

a sealed burner head with a plurality of tiers of burner ports, each tier containing a plurality of burner ports, each tier being at a different vertical elevation than the remaining tiers, all tiers being supplied with a fuel/air mixture directly from a common chamber within the burner head;

the burner head configured such that it will produce flame with a variable rate of heat transferance that can be varied by changing the rate at which the fuel/air mixture is supplied to the chamber.

2. The gas top burner of claim 1, wherein the tiers of burner ports are configured such that:

the number of tiers producing flame can be varied incrementally from one tier to all tiers by varying the amount of fuel/air mixture supplied to the chamber;

the number of tiers producing flame can be increased by increasing the amount of fuel/air mixture supplied to the chamber and decreased by reducing the amount of fuel/air mixture supplied to the chamber.

3. The gas top burner of claim 2, wherein a single ignition electrode is used to provide ignition for all tiers.

4. The gas top burner of claim 2, wherein a single flame sensor is used to detect the presence of a flame at any tier.

5. The gas top burner of claim 2, wherein a single device is used to both provide ignition for all tiers and detect the presence of a flame at any tier.

6. The gas top burner of claim 2, wherein the number of tiers of burner ports is two.

7. The gas top burner of claim 2, wherein the turndown ratio of the burner is at least 50:1.

8. The gas top burner of claim 2, wherein:

as the number of tiers producing flame is increased by increasing the fuel/air mixture supplied to the chamber, the tiers will produce flame in sequential order from the topmost tier to the bottommost tier;

as the number of tiers producing flame is decreased by reducing the fuel/air mixture supplied to the chamber, the tiers will stop producing flame in sequential order from the bottommost tier to the topmost tier.

9. The gas top burner of claim 8, wherein said sequential operation is not caused by internal pressure gradient.

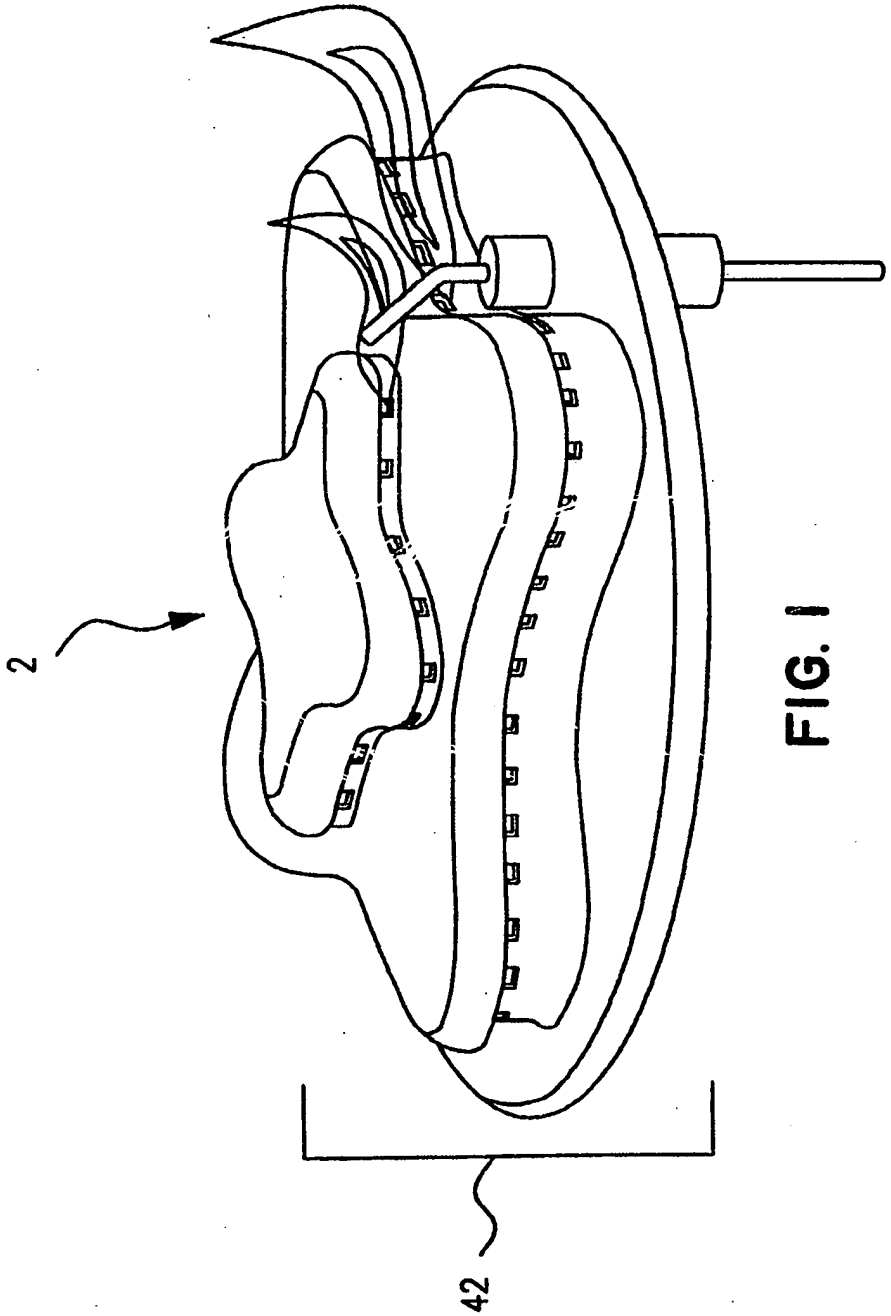


FIG. 1

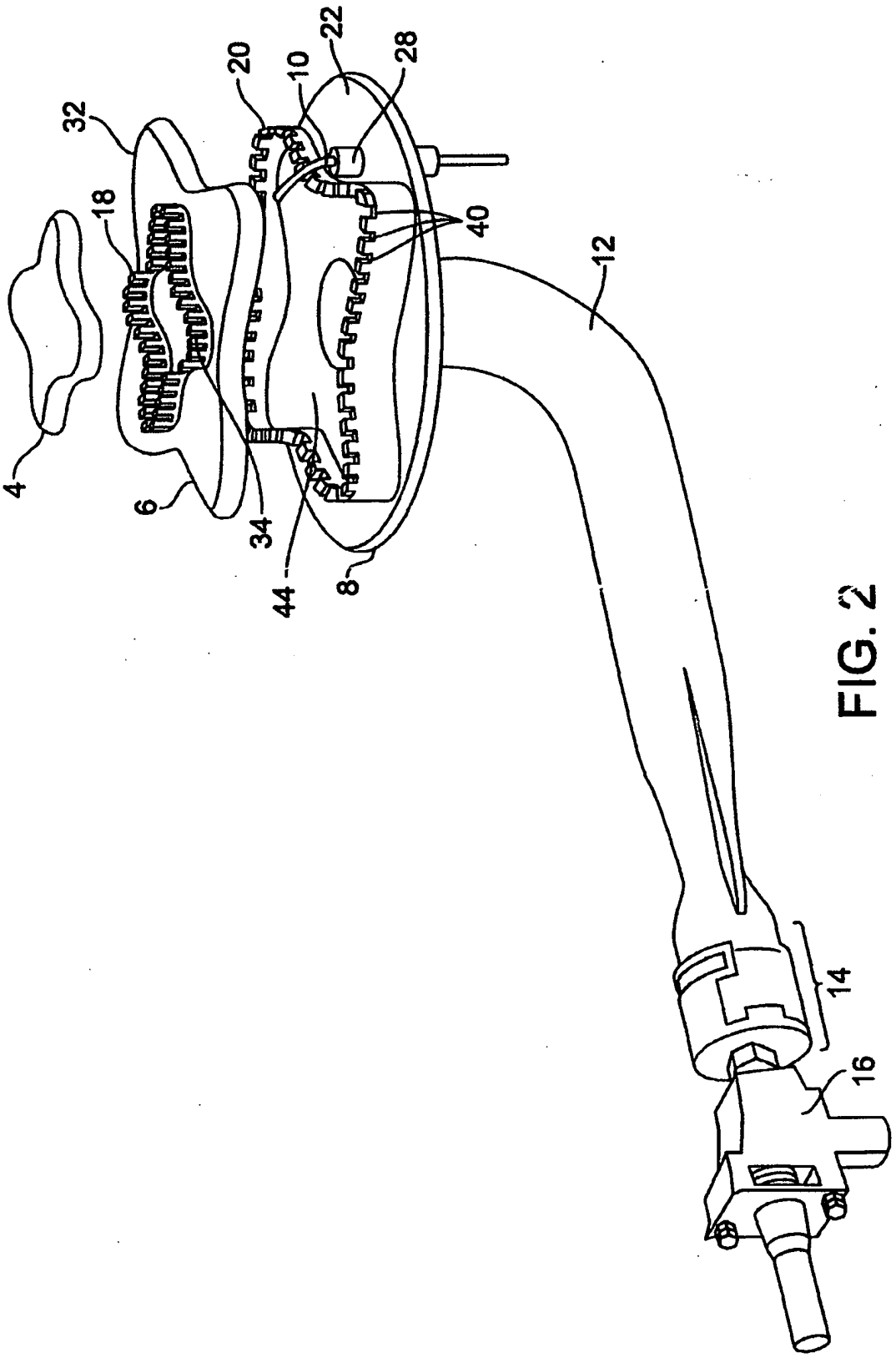


FIG. 2

FIG. 3

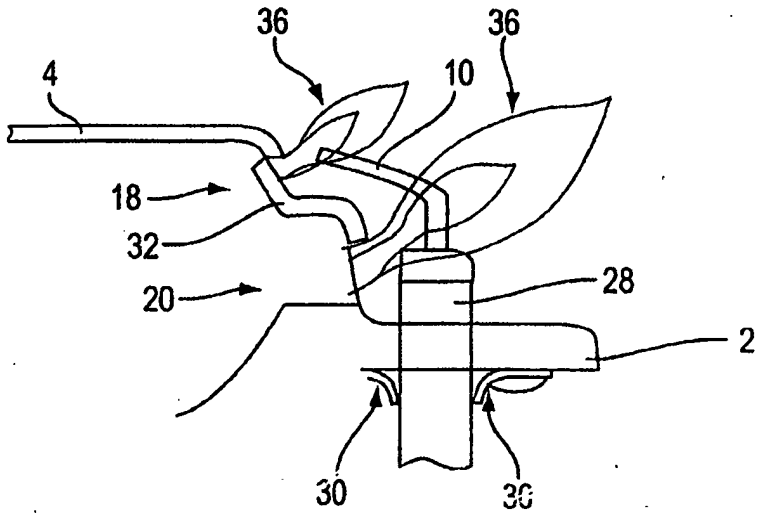
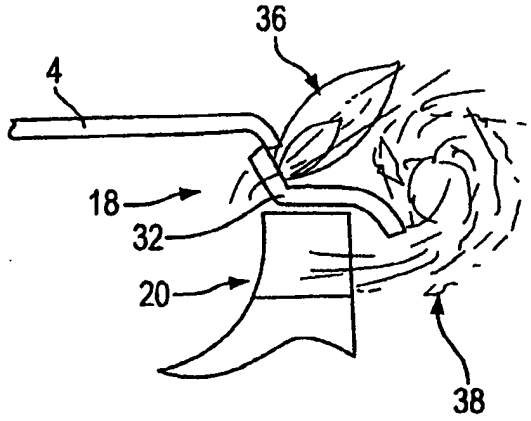


FIG. 4



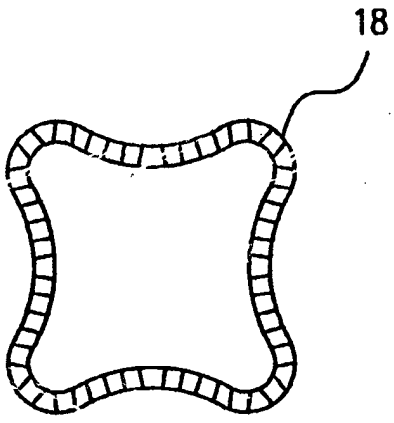


FIG. 5

INTERNATIONAL SEARCH REPORT

Ir .ational Application No
PCT/US 98/00358

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 F23D14/06 F23D14/58

According to International Patent Classification(IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 F23D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 554 511 A (ELEKTRO GAS ARMATUREN) 11 August 1993 see column 3, line 21 - column 5, line 35; figures 1-20	1-6
A	EP 0 485 645 A (MIRALFIN SRL) 20 May 1992 see abstract; figures 1,2	1

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☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
7 May 1998	18/05/1998

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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